1. (a) Explain different types of aerial photographs
(b) Explain with a neat sketch the components of a remote sensing system.

Answer:
(a):
Aerial photography is broken down into two main types, oblique and vertical configuration. Oblique refers to pictures taken the side of an aircraft and vertical images are taken from directly above the subject being photographed. Vertical aerial photography is normally used in real estate advertising. The process of taking photographs in the air from an aircraft is called aviation photography, as is taking pictures of aircrafts themselves. The main types of aviation photography are:

Air-to-air Photography
This type of photograph is used most often in advertising and entails taking pictures of an airplane from different angles. Of course the photographer is in another aircraft, since there has to be at least two aircrafts involved in air-to-air photography. This type of photography is practiced mainly at air shows.

Remote sensing
Remote sensing is used to gather information on the environment and other land base features from a distance, particularly from an aircraft in the sky using special equipment to gather and collect data. This explanation is one of many, but is best suited to aerial photographs.

Satellite
One major use of satellite photos is to gather environmental images so that scientists and environmentalists can track changes on the earth's surface. NASA and the U.S. Department of the Interior are two of the major agencies involved in satellite scanning in the United States.

Kite
The camera is mounted into a cradle and secured to a kite and sent flying; the pictures are taken by controlling the camera with a remote control. In some cases the camera is programmed to automatically snap pictures once the kite reaches a certain altitude.

Also included in aviation photography is the use of model planes and helicopters to take pictures. These are just some of the main types of aerial photographs

(b): Components of Remote Sensing:

1. Energy Source or Illumination: the first requirement for remote sensing is to have an energy source which provides electromagnetic energy to the target of interest.

2. Radiation and the Atmosphere: as the energy travels from its source to the target, it will come in contact with and interact with the atmosphere it passes through. This

interaction may take place a second time as the energy travels from the target to the sensor.

3. Interaction with the Target: as the energy travels from its source to the target through the atmosphere, it interacts with the target depending on the properties of both the target and the radiation.

4. Recording of Energy by the Sensor: after the energy has been emitted from the target, we require a sensor (remote -not in contact with the target) to collect and record the electromagnetic radiation. In order for a sensor to collect and record energy reflected or emitted from a target or surface, it must reside on a stable platform removed from the target or surface being observed. Platforms for remote sensors may be situated on the ground, on an aircraft or balloon (or some other platform within the Earth's atmosphere), or on a spacecraft or satellite outside of the Earth's atmosphere. Sensors may be placed on a ladder, scaffolding, tall building, cherry picker, crane, etc. Aerial platforms are primarily stable wing aircraft, although helicopters are occasionally used. Aircraft are often used to collect very detailed images and facilitate the collection of data over virtually any portion of the Earth's surface at any time.

5. Transmission, Reception, and Processing: the energy recorded by the sensor has to be transmitted, often in electronic form, to a receiving and processing station where the data are processed into an image (hardcopy and/or digital).

6. Interpretation and Analysis: the processed image is interpreted, visually and/or digitally or electronically, to extract information about the target, which was illuminated.

7. Application: the final element of the remote sensing process is achieved when we apply the information we have been able to extract from the imagery about the target in order to better understand it, reveal some new information, or assist in solving a particular problem.

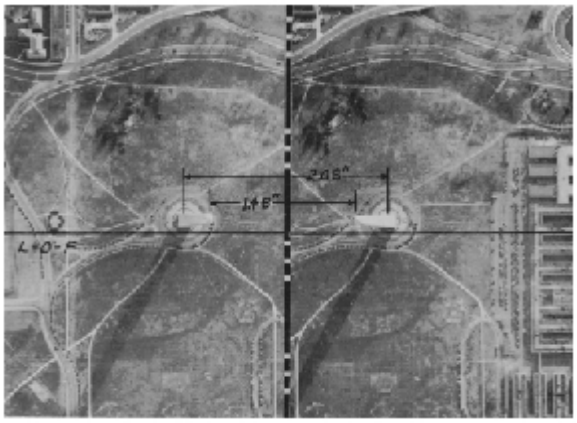
These seven elements comprise the remote sensing process from beginning to end.

2. (a) Write a brief note on stereoscopic parallax
(b) What are the major advantages of digital images over traditional hard copy images?

Answer:
(a) The displacement of an object caused by a change in the point of observation is called parallax.

Stereoscopic parallax caused by taking photographs of the same object but from different points of observation.

Adjacent but overlapping aerial photos are called stereopairs and can be used to measure object height



Note the displacement between the top and base of monument in this steriopair.

Calculating object heights using Stereoscopic parallax:
Absolute parallax-the average photo base length= average distance between PP and CPP

Differential parallax-the difference between the stereoscopic parallax at top and base of the object.

W.M. example: dp = 2.06-1.46=0.6 in

(b) Digital photography is a form of photography that uses an array of light sensitive sensors to capture the image focused by the lens, as opposed to an exposure on light sensitive film. The captured image is then stored as a digital file ready for digital processing (colour correction, sizing, cropping, etc.), viewing or printing.

Until the advent of such technology, photographs were made by exposing light sensitive photographic film and used chemical photographic processing to develop and stabilize the image. By contrast, digital photographs can be displayed, printed, stored, manipulated, transmitted, and archived using digital and computer techniques, without chemical processing.

Digital photography is one of several forms of digital imaging. Digital images are also created by non-photographic equipment such as computer tomography scanners and radio telescopes. Digital images can also be made by scanning conventional photographic images

Hard copy documents are extremely difficult to maintain. The actual physical task for maintaining paper documents is very labour-intensive as well as requiring a great need for storage space when filed. Additionally, gaining access to stored hard-copy documentation is quite tedious and annoying at best!

3. (a) List out various advantages and disadvantages of remote sensing
(b) Describe the procedure for parallax measurements for height.

Answer:
(a): Advantages of remote sensing:

1. Relatively cheap and rapid method of acquiring up-to-date information over a large geographical area.

Example:
Landsat 5 covers each area of 185x160km at a ground resolution of 30m every 18 days, cost of the original digital data is $5 000 (6 200 ha $-1, each hectare contains approximately 11 observations. Even with the cost of ground truthing this is very economical.

2. It is the only practical way to obtain data from inaccessible regions, e.g. Antarctica, Amazonia.

3. At small scales, regional phenomena which are invisible from the ground are clearly visible.

Examples:
Faults and other geological structures. A classic example of seeing the forest instead of the trees.

4. Cheap and rapid method of constructing base maps in the absence of detailed land surveys.

5. Easy to manipulate with the computer, and combine with other geographic coverages in the GIS.

Disadvantages of remote sensing:

1. They are not direct samples of the phenomenon, so must be calibrated against reality. This calibration is never exact, a classification error of 10% is excellent.

2. They must be corrected geometrically and georeferenced in order to be useful as maps, not only as pictures. This can be easy or complicated.

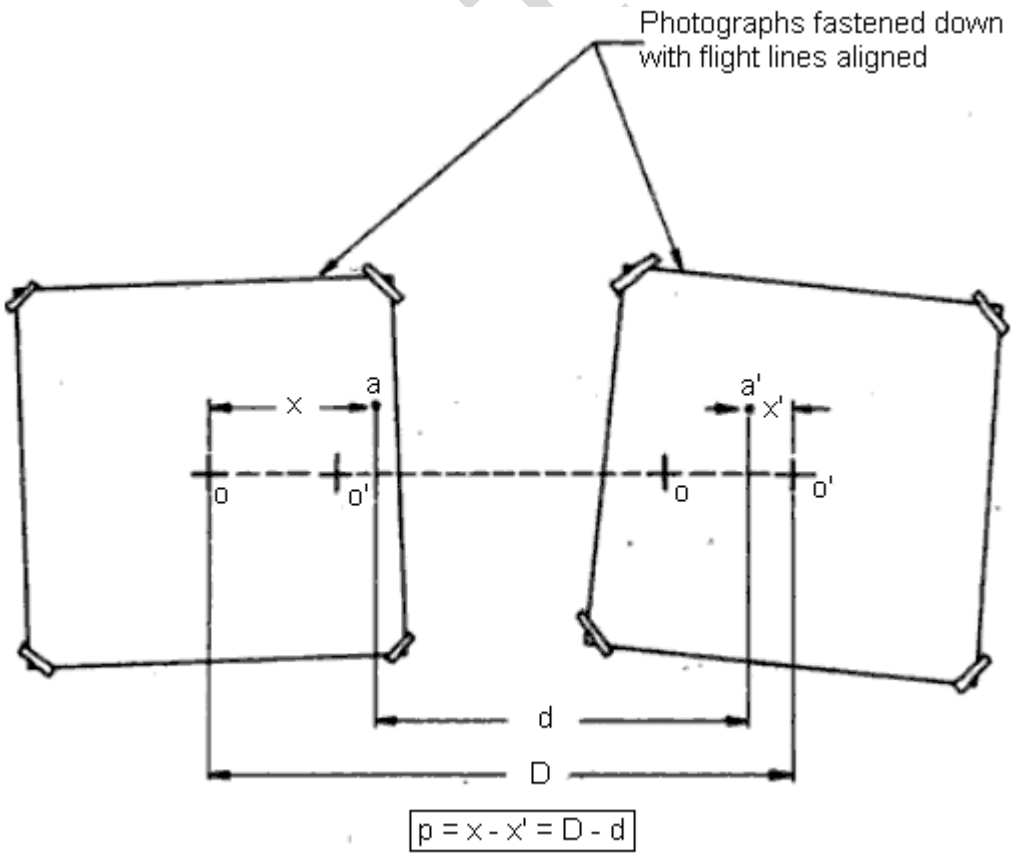
3. Distinct phenomena can be confused if they look the same to the sensor, leading to classification error.

Example: artificial & natural grass in green light (but infrared light can easily distinguish them).

4. Phenomena which were not meant to be measured (for the application at hand) can interfere with the image and must be accounted for.
Examples for land cover classification: atmospheric water vapor, sun vs. shadow (these may be desirable in other applications).

5. Resolution of satellite imagery is too coarse for detailed mapping and for distinguishing small contrasting areas. Rule of thumb: a land use must occupy at least 16 pixels (picture elements, cells) to be reliably identified by automatic methods. However, new satellites are being proposed with 1m resolution, these will have high data volume but will be suitable for land cover mapping at a detailed scale.

(b): Figure illustrates the principle behind methods of parallax measurement that require only a single measurement for each point of interest. If the two photographs constituting a stereopair are fastened to a base with their flight lines aligned, the distance D remains constant for the setup, and the parallax of a point can be derived from measurement of the single distance d. That is, p = D - d. Distance d can be measured with a simple scale, assuming a and a' are identifiable. In areas of uniform photo tone, individual features may not be identifiable, making the measurement of d very difficult.



Alignment of steriopair for parallax measuremnt

Employing the principle illustrated in Figure a number of devices have been developed to increase the speed and accuracy of parallax measurement. These devices also

permit parallax to be easily measured in areas of uniform photo tone. All employ stereoscopic viewing and the principle of the floating mark. This principle is illustrated in Figure. While viewing through a stereoscope, the image analyst uses a device that places small identical marks over each photograph. These marks are normally dots or crosses etched on transparent material. The marks - called half marks-are positioned over similar areas on the left-hand photo and the right-hand photo. The left mark is seen only by the left eye of the analyst and the right mark is seen only by the right eye. The relative positions of the half marks can be shifted along the direction of flight until they visually fuse together, forming a single mark that appears to "float" at a specific level in the stereomodel. The apparent elevation of the floating mark varies with the spacing between the half marks. Figure illustrates how the fused marks can be made to float and can actually be set on the terrain at particular points in the stereomodel. Half-mark positions (a, b), (a, c), and (a, d) result in floating-mark positions in the model at B, C, and D.

A very simple device for measuring parallax is the parallax wedge. It consists of a transparent sheet of plastic on which is printed two converging lines or rows of dots (or graduated lines). Next to one of the converging lines is a scale that shows the horizontal distance between the two lines at each point. Consequently, these graduations can be thought of as a series of distanced measurements as shown in Figure.

4. (a) Explain the necessity of ground control points for aerial photography
(b) List various photogrammetric activities and explain any one in detail.

Answer:
(a):
The ground control points appearing in photographs are required to linked to the ground point of known locations. To achieve this they must be few points appearing in photographs whose coordinates w.r.t ground reference co-ordinates systems. Ground control is also required for the orientation of photo in space relative to ground. The number of ground control points depends on navigational control cartographical process of map making. The ground control for aerial photogrammetry is classified as

1. Horizontal
2. Vertical control

(b) No Answer

5. a. Explain the fields of applications of Photogrammetry.
b. Explain the advantages of aerial surveys over conventional ground surveys.
(8 +8)

Answer: In the field of Photogrammetry, Intec Info.com provides services in photogrammetry using Satellite images as well as aerial photographs. Thus enabling the user base to make use of and analyze the data in a heterogeneous environment for**:**

1. Aerial photography interpretation

2. Stereo-pair digital orientation

3. Digital aerial photography geographical mosaic

4. Digital aerial photography rectification and geometric correction

5. Building height measurement by digital stereo aerial photography

6. Spot height extraction by digital stereo aerial photography

7. Contour line generation by digital stereo aerial photography

8. Digital terrain model generation by digital satellite stereo-pair

Satellite photogrammetry, which uses images from earth observation satellites, makes it possible to determine the shape, dimensions and positions of observed phenomena in a given reference system. It applies the same rigor as digital photogrammetry based on aerial photography with accuracy that depends on data resolution.

Satellite photogrammetry has been a major step forward in the mapping as it facilitates to map large areas with very few images taken by satellites and is cost effective compared with aerial photography. Aerial Photogrammetry can be used to scan a particular extent of area and the image specifications like scale, camera, time of photograph etc can be manipulated.

(b): There are many advantages in aerial survey for photographing the earth's surface may prove to be expensive, but it is very rapid. One flight of aeroplane may cover an area of thousands of square kilometers with in a day, while for a party of surveyors it would take several years.

1. Economy of life: In the initial stage, an aerial survey for photographing the earth's surface may prove to be expensive, but it is very rapid. One flight of aeroplane may cover an area of thousands of square kilometers within a day, while for a party of surveyors it would take several years.

In oil exploration, aerial photography was adopted as one of the main problems which prospecting companies had solved was to find a rapid method of constructing accurate geological maps, which were indispensable for geological exploration to facilitate and speed up the lengthy and expensive work of the geologist. For the geological work aerial photographs were found most suited to achieve the aim of quick and accurate geological has enabled the oil prospecting companies to make important saving both in time and money. For instance, photo geological survey in Sahara desert enabled the surveying party to make three quarter saving in terms of time and money.

2. Economy of money: In the initial stage, the expenditure on aerial photography is much more but in the long run the expenditure becomes many times less than the manual field work to cover the same area. The main expenditure includes the cost of an aeroplane, modern cameras and other equipment which are costlier than the films, photographic chemicals for development, printing etc. In the long run of aerial surveying not only the cost of equipment and planes is covered but the multipurpose uses of aerial photographs make it more economical.

3. Greater Accuracy: The maps prepared from photo geological techniques are much more accurate than those from conventional field work, because the possibility of human errors are greater in the latter case. On aerial photographs, the boundaries between the various geological formations, location of field objects or the cultural features are reproduced as a accurately as they actually occur in the area. However, there is a possibility of errors in case of oblique photographs or even the vertical photographs due to relief displacement in the region of high relief. Such errors can easily be rectified by various simple photogrammetric instruments. A better photo-interpretation is based on better known facts about the region that results in greater accuracy. It is important to collect all the existing geological information of the area, both before and during photo-interpretation to help in the preparation of sound and reliable geological maps. Therefore, there must be a close co-operation between the field of geologist and the photogeologist. It is desirable and sometimes necessary for the latter to make short trips to the field for photogeological field check.

6. a. Describe the types of aerial photographs.
b. Write notes on stereoscopic study of aerial photos. (12+4)

Answer:
(a): The two main branches of aerial photography are those known as "oblique aerial photography" and "vertical aerial photography"; the latter is sometimes also referred to as "overhead aerial photography". Above It All Aerial Photography supplies of both of these and further information on our oblique and vertical services can be found on their dedicated pages of this website.

Oblique aerial photographs are taken from some kind of aircraft whether this is a fixed wing aeroplane, helicopter or "lighter than air" craft (balloon). The subject is seen at an angle and therefore the photographs are perceived by the human eye as having depth and definition. As the name suggests, vertical aerial photographs are taken from directly overhead looking down vertically and they therefore produce a mostly flat image almost like a map. Both methods were largely developed for military purposes both also have many civilian uses. Oblique aerial photography is commonly used for construction progress reports, archaeology, advertising and promotion work, in the sale of commercial and residential property and land, in legal disputes or just to produce a stunning aerial photograph for display.

Vertical aerial photographs are most commonly used for mapping projects, for land use or geomatic surveys, farm evaluation, flood risk assessment and scientific studies. A

growing number of alternative photographic techniques are referring to themselves as aerial photography when in fact they may more properly be called "elevated photography". These techniques employ the use of various equipment to raise a camera above the ground to an elevated position. The method used to raise the camera varies and examples include the use of telescopic poles or masts, kites or even the use of a portable raised platform on which the photographer can stand. If you are interested in using elevated mast photography, this is a service provided by Above It All Commercial Photography.

(b): Stereoscopic study of aerial photographs:
Although the importance of soil survey has been constantly emphasized as a means for obtaining the necessary and basic information for the study of many kinds of land problems, soil survey organizations seldom have the adequate facilitates and support to carry out their tasks, develop their program to promote the solve the two following problems has contributed strongly to this situation:

1. The comparatively high cost of soil surveys, and

2. The length of time required to prepare them.

Recognising these handicaps which have been hindering soil survey organizations and retarding their growth, alternative methods for producing soil maps have becomes the object of research in some far-sighted institutions.

Increased emphasis has been gradually placed on the study of aerial photographs in an attempt to extract from these photographs all the information they contain and which may be related or made useful for soil mapping. More recently techniques based on the stereoscopic analysis of aerial photographs were developed. These techniques have been subjected lately to tests under vastly different environmental conditions. They were used, for example, in formations of Brazil and in the desert and semi-desert land scapes of the middle east.

7. a. Explain the flight planning and designing in aerial photography.
b. Write short notes on mosaic king. (10+6)

Answer:
(a): Flight planning is the process of producing a flight plan to describe a proposed aircraft flight. It involves two safety-critical aspects: fuel calculation, to ensure that the aircraft can safely reach the destination, and compliance with air traffic control requirements, to minimize the risk of mid-air collision. In addition, flight planners normally wish to minimize flight cost by appropriate choice of route, height, and speed, and by loading the minimum necessary fuel on board.

Flight planning requires accurate weather forecasts so that fuel consumption calculations can account for the fuel consumption effects of head or tail winds and air temperature. Safety regulations require aircraft to carry fuel beyond the minimum

needed to fly from origin to destination, allowing for unforeseen circumstances or for diversion to another airport if the planned destination becomes unavailable. Furthermore, under the supervision of air traffic control, aircraft flying in controlled airspace must follow predetermined routes known as airways, even if such routes are not as economical as a more direct flight.

The Missouri Highway and Transportation Department (MHTD) has been using GIS technology for several years in various projects and applications. The GIS staff consists of personnel from the GIS Section of the Planning Division with programming support from the Information Systems Division. ArcInfo and ARCVIEW2 are used extensively for Planning's activities and to a lesser degree in other MHTD divisions. GIS and its possible uses are quickly being realized by other divisions.

One of the primary sources of information for the department's design operations is aerial photography. Aerial photographs are acquired by pilots of the Equipment and Procurement Division and photographers of the Photogrammetry Section of the Design Division. The flight planning necessary to determine the locations of the flight paths for this photography is very repetitive and time extensive.

(b): Mosaic king applies not only to images but also to thematic layers and digital elevation models or any two spatial images requiring alignment. As an example, anyone familiar with U.S. digital ortho quads will know they are in tiles, which can be aligned seamlessly for one larger image. Satellite imagery is small scale (covering a large area) usually greater than 100 sq. km/frame. If a larger area is to be viewed then two or more of these frames must be connected together. Aerial photos on the other hand are large scale (covering a small area) in 23cm X 23cm format usually. Scale may vary for each of these images, particularly for aerial photos where flying height varies. In the case of aerial photos there is usually 60% side overlap and 30% end overlap for each pair of photos. Aerial photos, depending again on scale cover smaller areas - usually less than 10 sq km/frame. It may take 100’s if not thousands of aerial photos to cover the same area as one satellite image.